

An empirical case study of contrasting chemical depletion of hillslope regolith and eroding sediment, and implications for soil-derived catchment weathering rates

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The chemical depletion observed in hillslope soils has been used together with measurements of catchment-wide erosion rates to determine the rates of weathering [1] in a wide range of global settings. Results from applying this method imply a close link between erosion and weathering over several orders of magnitude [2]. This contrasts with data from hydrochemical mass balance in catchments, which indicate a regime of kinetically limited weathering rates when the supply of unweathered rock material is abundant [3, 4]. Resolving this discrepancy is critical to understanding the relative importance of climate and erosion in determining rates of chemical weathering, with important implications for understanding landscape evolution and long-term climate.

Here we present the initial results of an in-depth study of bedrock, soil, and actively eroding sediment in a small forested research catchment in northern Taiwan, at the FuShan Experimental Forest. Results of long-term monitoring of the composition of the eroding sediment shows that hillslope material is systematically more altered than the average material being eroded. This suggests that calculations linking the chemistry of hillslope material to catchment-wide erosion rates may overestimate chemical weathering rates, particularly at high erosion rates where they show the greatest discrepancy when compared to solute-derived rates.

[1] Riebe *et al.* (2001) *Geology* **29**, 511-514. [2] Riebe *et al.* (2004) *Earth Planet. Sci. Lett.* **224**, 547-562. [3] White & Blum (1995) *Geochim. Cosmochim. Acta* **59**, 1729-1747. [4] West *et al.* (2005) *Earth Planet. Sci. Lett.* **235**, 211-228.

In situ analysis of the molecular organic and elemental composition of a 3.33 Ga microbial mat from Barberton

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Microbial structures on the Early Archaean Earth are µ-scale in size although communities and mats may form larger assemblages up to the cm-scale. The small size of the structures necessitates the use of specialised complementary analytical techniques to characterise them and to ascertain their biogenicity. We used synchrotron radiation and NanoSIMS to investigate the compositional structure of a 3.33 Ga-old microbial mat. The 5-7 µm thick mat consists of alveolar kerogen that has been calcified apparently by primary aragonite. A thin layer of non-calcified kerogen underlies the hydrothermal silica-coated surface and occurs in isolated spots within the calcified part of the mat. N and up to 500 ppm organic S are associated with the kerogen, and molecules containing C-H, C-O, C-N, C-S, C-C stretches include thiophene. The carbonate contains traces of Fe, Mg, Cr and sulphate with minor organic S. The structure of the mat, its calcification, and presence of thiophene confirm its biogenicity, and the combined morphological and geochemical data suggest that the mat contained coexisting anaerobic photosynthetic communities, as well as SRBs.